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Enhanced Stage Variability on the Lower Missouri River as Benchmarked by Lewis and Clark: Implications for Ecosystem Restoration

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Because lower Missouri River management began in the early 1800s, a challenge for present-day ecosystem restoration efforts is a lack of quantitative data on pre-management river hydrology and long-term (100+ yr.) river response to changing management practice and intensity. We address this challenge and report new results from a study spanning 200 years of lower Missouri River hydrology, encompassing natural, channelization-only, and channelization with reservoir release regimes (Ehlmann & Criss, Geology, forthcoming, Nov/Dec 2006). Data from the 1803-6 Lewis and Clark expedition and continuous daily stage records extending from the 1870s were used to quantitatively benchmark pre-management hydrology of the lower Missouri River. Magnitude and timing of hydrologic change was assessed using a new, robust stage change technique which tracks variability in water level. Before 1900, daily stage change approximated pre-settlement values. However, doubling in daily stage variability occurred from 1900 to 2005. Annual maximum stages have, at some sites, become 40% more extreme relative to the median, and seasonality is more variable. Observed changes in stage variability began as early as 1900, suggesting that channelization is the major driver, not release from upstream reservoirs constructed since 1933. Enhanced flood stages at high discharges are observed, consistent with previous work (Criss & Shock, 2001; Pinter & Heine, 2005). Enhanced stage fluctuations also adversely affect stability of river habitats, in particular sand bar availability for nesting sites and provision of shallow water habitat for spawning. Present ecosystem restoration efforts focused on timed reservoir releases will not ameliorate these unnatural fluctuations. We suggest that restoring hydrologic parameters similar to those recorded by Lewis and Clark requires addressing channel morphology, i.e. widening the river in selected reaches. Efforts to reunite the Missouri River with its floodplain, via removal of channelization structures in designated areas, should continue and be expanded.